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THE DIVERSE HABITATS OF THE EASTERN RED CEDAR AND THEIR INTERPRETATION

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The red cedar of Eastern North America, *Juniperus virginiana* L.* (also called in some recent books *Sabina virginiana*) is noteworthy for the variety of habitats in which it is found; and some writers have regarded it as almost indifferent to environmental conditions.

On the coast of Long Island, Georgia, northeastern Florida, and no doubt at many intermediate points, *Juniperus* grows on the borders of salt and brackish marshes, and in Georgia—perhaps not so much farther north—it is frequent on low sandy islands in the marshes. It is said to grow on dunes on the shores of Lakes Michigan and Erie, and at many places on the Atlantic coast. In West Florida and perhaps elsewhere it is found in the estuarine swamps of muddy rivers. In Middle Georgia, particularly in DeKalb, Rockdale and Columbia Counties, it is frequent, though not abundant, on flat almost bare exposures of granite; and in Alabama and several other states it can be

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* The cedars of central Texas, the Rocky Mountain region and farther west, formerly referred to this species, have been separated by various authorities in recent years, probably with good reason. At the same time those of Florida and neighboring parts of other states have been referred to a West Indian species, *J. Barbadosensis* L. But the alleged differences between the northern and southern cedars seem to be no greater than many other trees exhibit in different habitats, and no one has ever succeeded in drawing a sharp line between them on the map. If the Florida cedar was really identical with a West Indian one we would naturally expect to find it in the extreme southern part of the state, like many other tropical trees; but no *Juniperus* seems to have been reported south of Brevard County on the east coast and Manatee on the west. Just what the relationship is between our cedar and those of Bermuda and the Bahamas does not concern the present paper.

seen on sandstone cliffs of various ages, from pre-Cambrian to Carboniferous.

The headquarters of our cedar seem to be in the interior hardwood region of Eastern North America,* from southern Ontario to northern Alabama. There, from all accounts, it was very abundant in the pioneer days, especially on bare limestone rocks, forming the great cedar-glades of Middle Tennessee and adjacent territory, which have been mentioned by many observers (though strange to say no illustrations of them seem to have yet found their way into botanical or geographical literature).

In addition to its natural habitats (of which those already mentioned do not exhaust the list), in southern New England, adjacent New York, and many other places the cedar is most commonly seen scattered in dry pastures and abandoned fields; and in nearly all parts of its range, particularly in the Piedmont region of Virginia, it is a familiar feature of roadsides and fence-rows. It is so common in such artificial or unnatural situations that it would be a difficult task to reconstruct its original distribution.

In most of the places above described *Juniperus* does not have much competition from other trees; but in Florida and some parts of the coastal plain of Georgia and Alabama it is usually found in dense calcareous hammocks, where it is pretty well shaded, even when full grown. It grows in shady places outside

* The interior hardwood region is not a sharply defined geographical unit, but it has certain distinctive characters besides the prevalence of hardwoods and the scarcity of pines. (On this latter point see Gattinger, Fl. Tenn. (ed. 2), 23-24, 1901.) Among them are: rock strata mostly Paleozoic and approximately horizontal, scarcity of sand and peat, wet winters and dry summers (in this connection see Gannett, U. S. Geol. Surv. Water Supply Paper no. 234, pl. 2, 1909), considerable seasonal fluctuation of streams, and frequency of polypetalous spring flowers, medicinal plants, and trees with durable dark-colored heart-wood.

There are in the United States about two dozen places named Lebanon, half a dozen New Lebanons, and a few others in which Lebanon forms a part of the name. Quite a number of these are in the interior hardwood region, and it is extremely probable that some of them (especially those in Kentucky, Tennessee and Alabama) were named from the abundance of cedar near by, in allusion to the classical "cedar of Lebanon." Although there is not much resemblance between our cedar and *Cedrus Libani*, the cedar of Lebanon, the people who named most of these places were probably not familiar with the Old World tree, which is not often cultivated in this country.

of the coastal plain, too, at least as far inland as Jefferson County, Alabama. There the characteristic spindle-shaped northern form abounds in old fields and rocky pastures between Birmingham and Bessemer, and the Florida form with loose drooping twigs is scattered through the flatwoods southwest of Bessemer, where it is well shaded by tall oaks and hickories.

In the numerous descriptions of the habitat of the cedar in the northern United States little or nothing is said about its having any particular fondness for lime. But in Alabama and adjoining states, where it is most abundant on limestone rocks, it is generally regarded as a lime-loving tree.* If it is, though, it differs strikingly from all other lime-loving trees of Eastern North America in having scale-like evergreen leaves, which is supposed to be a xerophytic adaptation. An explanation of its apparent fondness for lime will be suggested presently.

Notwithstanding the great adaptability of the cedar to diverse conditions of soil and climate, there are in eastern North America four rather widespread classes of natural habitats where it is conspicuous by its absence: (1) the great northern coniferous forests, extending from New Brunswick westward; (2) the common dry woods with oaks and hickories, which are represented in nearly all the eastern states; (3) the prairies, extending from Indiana westward; and (4) the pine-barrens, including the *Pinus rigida* barrens of Long Island and New Jersey, the *P. palustris* barrens from North Carolina to Texas, and the *P. Caribaea* barrens of South Florida.

Now if the various habitats of our tree can be found to have any one character or combination of characters in common, not shared by the other habitats just named, we will have the key to the situation.

One such character stands out prominently. The coniferous forests, dry woods, prairies and pine-barrens are burned over at intervals of a few to several years (the fires being set oftener now by man than they were by lightning and other natural causes in prehistoric times), while *the habitats affected by the cedar are rarely or never visited by fire.*

* See bibliography at end of this paper.

The sensitiveness of *Juniperus virginiana* to fire, a natural consequence of its thin bark,* has been commented on in some of the general works cited below, if not elsewhere; but the geographical significance of this fact seems never to have been pointed out before.

The various habitats of the cedar are protected from fire in different ways. Marshes and estuarine swamps are usually too wet for fire to travel through, and on dunes and rocks (the latter including the cedar-glades) the herbaceous vegetation is too sparse to feed flames. The exemption of pastures and fence-rows from fire is too obvious to require any further comment. In the Florida hammocks, as in other climax forests, the humus does not burn readily, partly because it is usually too damp, and partly because most of the carbon in it is already oxidized.†

The abundance of cedar on limestone rocks may now be partly explained by the fact that such rocks are most extensively exposed in the interior hardwood region and in other regions which were characterized originally by vast climax forests and now by cultivated fields, where forest fires from natural causes are and always have been very infrequent, apparently. It is possible, however, that a little lime in the soil may be advantageous to our tree, for it seems to be entirely absent from the fall-line sand-hills and stream sand-hills of the coastal plain, which are almost exempt from fire but decidedly non-calcareous; while the dunes on the coast must contain appreciable quantities of calcium carbonate in the form of comminuted sea-shells. Furthermore, outside of the glaciated region *Juniperus Virginiana* seems rarely or never to associate with any of the Ericaceae, a family of plants noted for their preference for acid soils.‡ Never-

* Its usually shallow root-system has been suggested as another factor which makes the cedar an easy prey to fire; but it would be hard to find a tree with shallower roots than *Pinus Caribaea* where it grows on limestone rocks southwest of Cocoanut Grove, Florida, and that species is almost immune to fire. The cedar usually branches near the ground, and that is probably another reason why it is more liable to injury by fire than some other trees.

† In this connection see Bull. Torrey Club 38: 524. 1911.

‡ In this connection see Hilgard, Soils 522. 1906; Coville, U. S. Bureau of Plant Industry Bull. 193: 19, 30. 1910; Harper, Ann. Rep. Fla. Geol. Surv. 3: 361. 1911.

theless, the evidence here presented seems to show that the cedar dreads fire more than it likes lime.

Notwithstanding its tolerance of shade and sensitiveness to fire, in which it differs from many other conifers and most pioneer trees, the cedar has other pioneer characters besides its "xerophytic" leaves. It thrives in very thin and poor soils, and is rarely found native in deep rich soils, especially those of alluvial bottoms, where fire-protection is almost at its maximum. In the blue-grass region of Kentucky, which is characterized by rich calcareous soils, it seems to be chiefly confined to dry rocky places, such as the cliffs of the Kentucky River. The Florida hammocks in which our tree abounded before it became the prey of the pencil-makers are very near sea-level (and usually rocky as well), and the marshes and estuarine swamps are of course still lower; so that in all such places the ground-water level is at all times so near the surface that there is only a shallow zone in which aeration can take place and the common soil-forming agencies can work. Perhaps the cedar has little use for earthworms and other nitrogen-producing organisms; its relations to these things deserve investigation.

The following list contains references to about 400 places, mostly in easily accessible publications, where the habitats of *Juniperus virginiana* (as that species is defined at the beginning of this paper) in various parts of Eastern North America are mentioned. No attempt has been made to refer to places where it is merely listed as growing in a certain region, without any indication of habitat, except in a very few cases of special interest. The references for each state are arranged chronologically as far as possible, and the states alphabetically. It may seem tiresome to cite so many pages of the same book in some cases, but the reader who is not sufficiently interested to go into the matter deeply can at least get from this a crude idea of the relative abundance of cedar in each state, and one who may be making a special study of the vegetation of any one state will probably find a multiplicity of references useful.*

* I have found nearly all these references in the libraries of either the Geological Survey of Alabama or the New York Botanical Garden. Most of those relating to Iowa were first brought to my attention by Prof. L. H. Pammel.

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